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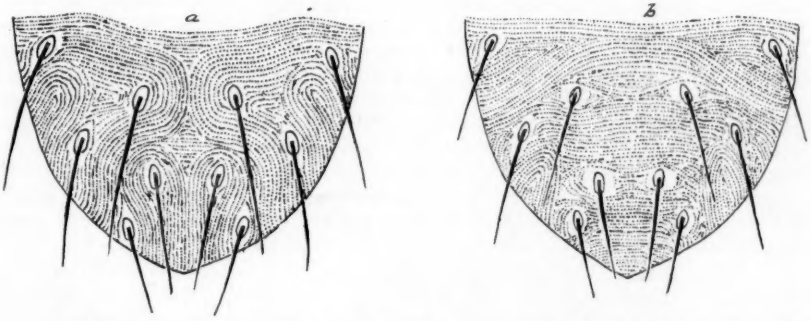
## A NEW CHARACTER DISTINGUISHING *TETRANYCHUS PACIFICUS* McGREGOR FROM *T. TELARIUS* L.*

BY A. D. HERIOT,

Dominion Entomological Laboratory, Vernon, B. C.

The generic characters of the Tetranychidae lie in the tarsal appendages, particularly the claw. The palpi and shape of the male sexual organ are used mainly for the determination of species. These specific characters are depicted in profile; thus, in order to observe them the mite must be mounted and flattened dorso-ventrally. This entails a considerable amount of manipulation, and a high magnification is necessary in order to obtain definition of the minute details.




Caudal portion of female mites, dorsal aspect. a, *Tetranychus telarius*. b, *T. pacificus*

MsGregor's description and drawings† of *Tetranychus pacificus* and *T. telarius* furnish only one reliable character for separating these very similar mites. This consists of the aedeagus of the male, which is sharply spurred in *pacificus* and bluntly terminated in *telarius*. Males unfortunately occur only during the summer, whereas the females can be procured throughout the year, and it is during the spring and fall that determinations are most likely to be required. Both species pass the winter as hibernating females, and the apple is a host plant common to both.

A ready means of distinguishing between the females of *pacificus* and *telarius* is provided by the pattern of the integument. Under a dry objective, the integument is seen to be finely striated. The general course of these striations is transverse on both dorsum and venter, but on the caudal half of the abdomen of *telarius*, as the lines approach the mid-dorsum, they are deflected longitudinally. This is in sharp contrast to the continued transverse lines of *T. pacificus*. These contrasting striations are shown diagrammatically in the accompanying figures, and this distinguishing character applies to the deutonymph as well as the adult female.

*Contribution No. 2040, Division of Entomology, Science Service, Department of Agriculture, Ottawa, Canada.

†McGregor, E. A. The red spiders of America and a few European species likely to be introduced. Proc. U. S. Nat. Mus., 1920, p. 657.

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# COMMENTS ON THE SUPRA-SPECIFIC CATEGORIES OF NEARCTIC TABANIDAE (DIPTERA) *

BY CORNELIUS B. PHILIP

United States Public Health Service, Hamilton, Montana

As material increases and taxonomic information is refined in any group of organisms, it is a natural corollary that the systematic arrangement by its students should be in the direction of progressive limitation, restriction, or subdivision to facilitate either or both recognition and knowledge of natural relationships. It is also natural that opinions of various taxonomists regarding a given group should vary, and since nature never deals in systematic names *per se* as they are simply the "handles" we apply for convenience, perhaps we are inclined to be unduly concerned as to whether our fellow workers are too radical ("splitters") or conservative ("lumpers") from our personal points of view. The ideal system of nomenclature in a given group would be that which facilitates recognition and reference in accord with natural phylogenetic relationships, but here again opinions differ as to what actually is the natural, rather than artificial or arbitrary arrangement. Nevertheless, no matter how conservative the present day systematist, he soon comes to realize, (1) that any living group he studies is the effect of dynamic processes and only appears in a temporarily static condition because of the slowness of the process, (2) that its correlatively assigned systematic categories, though perhaps given arbitrary, equivalent rating, may actually be reflecting entirely different relative positions of time or progress in that dynamic picture (Townsend's viewpoint of "embryonic, nascent, mature and senile" systematic groups is very thought-provoking in this regard), and (3) that the continuing trend of systematization is and will be in the direction of further restriction of many previously large systematic categories. Consequently, the viewpoint of any one student determines his contribution to the rate with which such refinement progresses. Even the so-called "lumper" seldom completely returns to the older systematic arrangements.

The family Tabanidae has always been a favorite among dipterists, not alone for academic reasons, but because of its parasitic and potential, disease-carrying propensities. Of recent years, the restriction or subdivision of both generic and supra-generic categories in this family has been considerably accelerated, and in the opinions of many, more rapidly than needed for simple systematic recognition of described species. One finds such apparent incongruities as *Tabanus oculus* Walker related equally to either *Bellardia* on wing venation or *Lophotabanus* on the prescutellar "eye-spot", in two separate Enderlein subfamilies, or *Tabanus imitans* Wlk. and its variety *excessus* Stone keying to two different tribes in the Enderlein system. With due recognition of the above-mentioned trends toward restriction, the writer still ventures to eliminate certain of these categories as they would apply in a forthcoming catalog of Nearctic species, while adding others.

As stated elsewhere, he (1940) agrees with Ferguson and others in questioning any improvements to the systematic conception of the family in the mere elevation to sectional status of the long established subfamily concepts without change in character, but with new names. Furthermore, it should be pointed out that there is customarily no category inserted between the family and subfamily, that it is the usual practice to derive names at least as high as the family and superfamily from selected type genera, and that use of "section" as a category is preferred above the superfamily. In all these respects Lutz's Sections Opisthacanthae and Opisthanoplae, as perpetuated by Enderlein and Kröber, seem undesirable.

*Contribution from the Rocky Mountain Laboratory (Hamilton, Montana) of the Division of Infectious Diseases of the National Institute of Health.

However, there is no reason either why the hind tibial spurs are the only characters of phylogenetic importance for an adequate conception of the immediate subdivisions of the family, since they are present or absent, as the case may be, in certain otherwise quite unrelated generic groups as well as in allied families. The character is therefore merely one of systematic convenience and it is easily argued, on the other hand, that the Sections Opisthacanthae and Opisthanoplae, though merely new names for the old subfamily concepts, Pangoniinae and Tabaninae, are justifiable dichotomic aids by leaving the latter intact while adding other needed subfamilies.

The genera *Pelecorhynchus* (Australia), *Coenura* (South America), and *Bequaertomyia* (North America) are admittedly a compact and well differentiated, probably primitive ("senescent"?) element in the family because of the sinuate anal veins and open anal cells as also seen in some Coenomyiidae; the facial characters and strongly collapsed halteres are also unusual in Tabanidae. Most individual supra-specific characters are heterogenetic within the order, but since this group of genera represents a fundamental divergence in wing venation from the family type, there is no reason why the above genera should not be given subfamily rank irrespective of the presence of hind-tibial spurs. The subfamily Pelecorhynchinae, in fact, has already been proposed by Enderlein, but subordinated under his Section Opisthacanthae.

It may be added that an examination, admittedly limited, of a few species of *Pelecorhynchus* and *Coenura* does not substantiate their generic separation. While the "discus"-like truncation of the palpi of *Coenura* is more exaggerated than in any of the Australian species seen, apical excavation of the palpi is found to vary in different species of both. Furthermore, the differences in the eye facets used as a supporting differential character by Enderlein is fallacious, as also observed by Ferguson, while the remarkable abdominal specialization beyond the fourth segment is also found in both (as well as in *Bequaertomyia*). On the other hand, certain Australian species now assigned to *Pelecorhynchus* are found to have dichoptic eyes in the males, a striking and unusual condition in the family, and would appear to warrant generic recognition.

The name ARCHEOMYIA gen. nov. is here proposed for *Pelecorhynchus fulvus* Ricardo, as genotype species, and its relatives having widely dichoptic eyes in the male. At least *P. mirabilis* Taylor is also described with this character. Whether, in *fulvus*, the lack of hind tibial, ciliate fringes, antennae situated even higher on the front than in the observed *Pelecorhynchus* species seen, more elongate body and less strongly modified abdomen caudally, are of generic value, will have to await evaluation by one having better access to materials.

## CATEGORIES OF NEARCTIC TABANIDAE

### Key to Subfamilies

A. Anal vein sinuate, anal cell open at the wing margin; subepaulets bare, uninflated; frontoclypeus very swollen, the antennae situated above the middle of the head; abdomen (♀) modified behind the 4th segment into a slender, retractile, post-abdomen ..... Pelecorhynchinae End.

Anal vein straight or gently curved, usually joined to $Cu_2$ at or before the wing margin; subepaulets bare or hairy; frontoclypeus sometimes swollen or produced but shorter above, the antennae at or below the middle of the head; abdomen not with a muscoid-like ovipositor ..... B

B. Hind tibiae with two apical, usually strong spines; subepaulets bare, uninflated ..... Pangoniinae Loew.

Hind tibiae without apical spines like those of the mid-tibiae; subepaulets mostly hairy, but sometimes bare, often inflated ..... Tabaninae Loew.

## Keys to Tribes

I. Pelecorhynchinae. I. BEQUAERTOMYINI nov. One genus, *Bequaertomyia* Brennan, Pacific Coast of United States. Distinguished from exotic Pelecorhynchini by its more elongate marginal cells, particularly $R_4$, less collapsed halteres, densely hairy eyes and palpi not truncated apically. The hind-tibial, ciliate fringe is undeveloped as in *Archeomyia fulva*.

II. Pangoniinae.

A. Antennae 9-10 segmented (flagellum with at least 7 annuli, the basal one not greatly differentiated) .....1. Pangoniini End.
Antennae with not over 7 segments (flagellum with at most 5 divisions, the basal one considerably elongated) .....B.

B. Flagellum with 5 divisions; mostly slender, more delicate species.....
.....2. Chrysopini End.
Flagellum with 3 divisions; robust, *Tabanus*-like species with hind-tibial spurs small but distinct .....3. Merycomyini nov.

1. Pangoniini Enderlein. Five Nearctic genera*: *Goniops* Aldrich, *Apatolestes* Williston, *Esenbeckia* Rondani, *Stonemyia* Brennan, and *Pilimas* Brennan of which all but *Esenbeckia* are found only in North America so far as known, though at least the hairy-eyed *Pilimas* (Brennan erected this as a subgenus of *Stonemyia*) has undoubted affinities with the Australian genus *Scaptia* Wlk. Since *Ricardoa* End. is differentiated on relative lengths of female palpi to proboscis, with the males thus not separable, and individual variation occurs in the palpi of the two Nearctic species of *Esenbeckia,* the former is disregarded here.

2. Chrysopini Enderlein. Four Nearctic genera: *Silvius* Meigen, *Assipala* Philip, *Chrysops* Meigen, and *Neochrysops* Walton, of which only the last is peculiar to North America, though the species of *Assipala*† have so far been taken only in the Neotropical portion of this continent from Costa Rica as far north as southern Arizona. I cannot subscribe to the tribal separation of *Silvius* and *Chrysops* by Enderlein and Kröber, as indicated in my discussion (1940) of *Silvius* (*Zeuximyia*) *philipi* Pechuman, for to be consistent would involve similar treatment of *Assipala* and other exotic elements, while maintenance of Silviinae as a subfamily would also involve other inconsistent readjustments, and with small apparent systematic facility (there is already an equivalent category available in Chrysopinae Lutz).

3. Merycomyini nov. One genus *Merycomyia* Hine, peculiar to the United States, and set apart by its *Tabanus*-like build, weak hind tibial spurs, and peculiar, 3-segmented, third antennal segment. Stone (1938) correctly removed it from the following subfamily, where it was originally assigned.

III. Tabaninae. A neglected character of super-specific value in differentiation within this subfamily is the presence, on the subepaulets, of sparse to abundant hairs equivalent to those on the tegulae and costal veins in the more typical genera. These are absent in certain others, and in all pangoniine and pelecorhynchine genera known to the author (though microscopic pubescence may be present). *Diachlorus* and *Stenotabanus* in particular, previously have been awkward genera to key out. The character was at first thought to have supertribal value, the Nearctic Tabaninae forming two nice groups (which could have formed the supertribes Tabanoini and Diachloroini), but it was found that the Neotropical species of *Dicladocera* and *Phaeotabanus* apparently vary in this regard. In spite of the lack of such hairs on most Dichelacerini, including the genotype species of *Dicladocera, (guttipennis* Wied.), the hairs on the sub-

*A sixth genus, *Comops* Brennan, also belongs here.
†Genotype, *Chrysops tanycerus* O. S.

calli as well as the antennal structure, preclude more than subgeneric separation of *megerlei* and *finitima* with hairy subepaulets. Further restriction of this Nearctic group is discussed hereafter.

Random examination reveals bare subepaulets in such exotic Tabaninae as the Neotropical *Stibasoma, Acanthocera, Catachlorops, Amphichlorops, Dicladocera* (in part, including the genotype species), *Phaeotabanus* (in part), the Ethiopian *T. pallidofacies,* the Australian *T. victoriensis* and *froggatti,* and the Palaearctic *Dasyramphis,* as well as *T. apricus* and *graecus* which were placed in Kröber's typical group *bovinus.*

## Tribal Groups of Nearctic Tabaninae.

For systematic convenience these tribes may be treated in two groups, since the Neotropical species of *Dicladocera* prevents their consideration as supertribes.

Subepaulets without hairs ..... Group "a"
Subepaulets with as coarse hairs as those on costal veins, though occasionally more sparse ..... Group "b"

Tribal group "a". These are minor elements in our fauna which appear to represent extensions from the Neotropical region. Although *Bolbodimyia* was included by Kröber (1934) with *Stenotabanus* in his subfamily Stenotabaninae, they would hardly seem even tribally related. *Chlorotabanus* was further placed as a subgenus of *Tabanus.*

## Tribes of Group "a".

A. At least fore-tibiae swollen; wings extensively infuscated, no spur-veins ... B.
Tibiae normal; wings predominantly hyaline and normally with spurs at the bases of vein $R_4$ ..... C.

B. First antennal segment and face not swollen; eyes with diagonal bands in life ..... Diachlorini End.
First antennal segment and face swollen; eyes unicolorous .. Bolbodimyini nov.

C. Third antennal segment rather narrow, the dorso-basal angle slight; bodies slender with definite color pattern (♀ with frontal callosities); eyes banded in life. ..... Stenotabanini nov.
Third antennal segment broad with a prominent dorsal angle; bodies compact, unicolorous yellow or greenish (♀ with no frontal callosities); eyes unbanded ..... Chlorotabanini nov.

Diachlorini End. One genus, *Diachlorus,* and one species in this fauna, though more elaborated in the Neotropical Region.

Bolbodimyini nov. Stone (1938) has synonymized *Snowiellus* with the Neotropical *Bolbodimyia.* But two specimens of one species have so far been taken in Arizona only. The writer has compared the type of *Snowiellus atratus* Hine through kindness of Dr. R. H. Beamer and *B. bicolor* Bigot, the respective genotypes.

Stenotabanini nov. Kröber (1929, 1934) erected the subfamily Stenotabaninae to contain seven Neotropical genera; it is not known how many of these can be included in the tribe as here restricted. Three genera have Nearctic species, viz., *Stenotabanus, Agelanius,* and *Aegialomyia* discussed later.

Chlorotabanini nov. Only one species of the more Neotropical genus, *Chlorotabanus,* occurs in this country. The Georgia and South Carolina localities given by Kröber (1930) under *C. inanis* (Fabr.) undoubtedly refer to *crepuscularis* (Beq.) as the former is entirely Neotropical.

Tribes of Group "b".

A. Flagellum of antenna with 4 distinct divisions; first antennal segment considerably longer than thick ..... Chrysozonini nov.

Flagellum of antenna usually with 5 divisions (infrequently fewer by apical fusion); first antennal segment scarcely longer than thick ..... B.

B. Third antennal segment with a hook-like, dorso-basal extension; (Nearctic) eyes hairy and length at most 20 mm., usually less ... ?Dichelacerini End.

Third antennal segment seldom hook-like, and then eyes bare and very robust, at least 20 mm ..... Tabanini End.

Chrysozonini nov. This tribe, more highly developed in the Eastern Hemisphere, is represented by only three species of the type genus, *Chrysozona*, in this country. The original Meigen name is used here in conformity with the specific Opinion 28 (as well as 46) of the International Rules which has not been superseded by any subsequent action including, unfortunately, the Padua (1930) resolution quoted by Townsend (1935, pt. II, p. 18). Chrysozoninae (Haematopotinae) has been regarded as of subfamily rank by Enderlein, Goffe and others, and with some justification considering the distinct adult demarcation within the family. However, considering the typical conformity of the immature stages with *Tabanus*, as compared, for example, with those of *Goniops*, the writer prefers to differentiate the group no higher than tribally.

In the Enderlein system, the genera *Microtabanus* and *Glaucops* would be included (unnaturally in my opinion) in his subfamily Haematopotinae simply through fusion of the apical annuli of the antennae. The articulations are often indistinct, and the number of annuli variable in different specimens of *M. pygmaeus*, *G. fratellus* and *G. daedalus*, the three Nearctic species of these two genera; I have a specimen of *fratellus* in which the annuli are even plainly not reduced but *Tabanus*-like. The generic or subgeneric evaluation of the character in *Glaucops*, at least, is therefore legitimately open to question, and the group seems more logically a part of the Tabanini.

Dichelacerini End. Although the Nearctic species have hairy subepaulets in contradistinction to *Dichelacera* and the majority of the tribe in the Neotropical Region, it is preferred to keep them within this tribe for the present to which they seem most logically related. The five Nearctic species belong in *Dicladocera* subg. *Agkistrocerus* and in *Hamatabanus* described later. The species of the last, *scita* (Wlk.) and its relatives, are known to me only from this country at present.

Of the Nearctic bare-eyed species with an elongate antennal tooth, all gradients are found between *Tabanus atratus*, *americanus*, and *imitans*, through *fumipennis* and *giganteus* to those with little excavation. There appears no advantage in trying to find a limiting point where *Astigmatophthalmus* Kröber would apply, the type species *erebus* O. S. (syn. *satanus* Krb.) having this tooth a little more produced than *atratus* with which it appears congeneric as indicated by Stone (1938).

Tabanini End. This is the most complex of the Nearctic tribes and might be considered to be in the "nascent" condition of Townsend, or just approaching climactic, evolutionary elaboration, since so many of the elements are showing diversification without well-defined limits of older groups. The old *Tabanus sens. lat.* has been variously "split" and "relumped" according to several viewpoints in attempts to differentiate groups divergent from *T. bovinus*, the genotype. In its wide sense, the genus formed a convenient "catch-all" (or "dumping ground" as aptly put by Dr. Stone, correspondence) that had certain advantages to the cataloger, but little regard for divergent elements with obvious restricted affinities. Characters used for such restriction have resulted in cate-

gories from groups, and subgenera to tribes and even subfamilies. A universally acceptable evaluation is a matter for a reviewer with unlimited, world materials and wide dipterological experience. This has been attempted notably by Enderlein and Kröber, the former for world species, and the latter for the Palaearctic and Neotropical faunae in particular.

However, the former's material was too limited for certain areas, as pointed out by several subsequent critics, with some glaring inconsistencies resulting from attempts to force such heterogenetic characters as the closure of cell $R_5$, the presence of a spur at the base of vein $R_4$, or the occurrence of an elongate dorso-basal tooth on the third antennal segment into unnaturally equivalent values in different categories. While perfectly reliable in certain groups or regions, they have to be used with caution in others, and judgments of such reliability based on restricted geographic acquaintance (not excluding the present discussion of a Nearctic system!) are admittedly dangerous when extended, and yet to be valid in a natural taxonomy, should stand the test of such extension.

In attempting to avoid retaining *Tabanus* as a "dumping ground" for groups obviously diverging from congeneracy with *Tabanus bovinus*, the question may reasonably be raised, especially in keying and attempts to assign certain intermediate or atypical species, if subgeneric rather than generic treatment of certain weakly defined groups might not still be the preferable course. For a catalog of Nearctic species, the writer leaves *Tabanus sens. lat.* and subgenera with reluctance and only because he feels that will be the inevitable future course, already initiated by Stone (1938). In such treatment, there probably always will remain a debated and unavoidable group of *incertae sedis* which can be assigned to *Tabanus sens. str.* only with doubt, and because a point looms over the horizon where the student wonders if he has a genus or only a glorified species before him; e. g., an analogous situation to that in the mind of Osten Sacken when he criticized certain workers as describers of "a specimen not a species."

Complicating the nomenclature is the confused status of the hairy-eyed group with ocelligerous tubercles (usually without ocelli) assigned since Osten Sacken to *Therioplectes* of authors (not Zeller). Because these flies are not congeneric with the genotype, *T. tricolor* Zell., European and American students have of late assigned them to *Sziladynus* End., 1925, genotype *Tabanus aterrimus* Mg. of Europe. Congeneric also is *T. quadripunctatus* Fabr. of South America, to variations or synonyms of which have been given the names *Dasyphyrta* End., 1922, p. 344, *Hybopelma* End., 1922, p. 351, *Poecilosoma* Lutz, 1909 (not Hubner, 1816 and others), *Poecilochlamys* Lutz, 1928, and *Poeciloderas* Borgmeier, 1933 (Lutz of authors). As Stone has pointed out (correspondence), *Poeciloderas* was first used in a list by Lutz in 1921, but appears not to have been validated until assignment of the genotype by Borgmeier in 1933. Because of the prominent ocelligerous tubercle in typical *quadripunctatus*, as indicated by Fairchild, the species is congeneric with the whole of the Nearctic group, and not restricted to *"reinwardtii* and related species" which Stone (1938) related to *Poeciloderas*.

*Sziladynus* therefore appears antedated by several of Enderlein's 1922 names. In addition to *Dasyphytra* and *Hybopelma* (syn. *Hypopelma* End., 1925), apparently congeneric also in this group are Enderlein's 1922 names, *Dasyommia* and *Hybomitra*, and possibly *Stypommia* and *Tylostypia*. The genotype of the last, *T. astur* Erichs., I no not know, but at least three of his four included North American species are well known and not separable generically from the group; one of these, *T. lasiophthalmus* Macq., almost always lacks the supposed generic character of the spur-vein, and the frontal characters closely duplicate the ascribed distinguishing frontal characters of the females of *Hybomitra solox* End. (=*T. rhombicus* O. S.) and other species. As prominence of the subcallus varies both sexually and interspecifically, it hardly provides a

good character for even subgeneric division of the group. Since the genotypes of the first two are variable and unsatisfactory, and that of *Dasyomnia* is not representative, the writer here selects *Hybomitra* as having the genotype most characteristic of the group by authority of Article 28 of the Rules accorded the "first revisor" to choose the name of equal date "most pertinent" (paragraph a) other things *not* "being equal" for recognition of page priority (paragraph c). Moreover, the genotype, *T. rhombicus,* is among our closest relatives to *T. aterrimus* Meig., genotype of *Sziladynus* except for the denuded subcallus.

The question then arises of how to treat the anomalous group of Nearctic flies with hairy eyes but no ocelligerous tubercles, represented by *reinwardtii* O. S., *stonei* Philip (MS), *gilanus* Twns., *laticeps* Hine. *orbicallus* Philip, *laticornis* Hine, *erythraeus* Bigot, *pruinosus* Bigot, and *fairchildi* Stone. The amount of ocular hairiness varies in decreasing order, reaching a point difficult of separation from certain *Tabanus* spp. with microscopic hairs on the one hand, and from variants of *T. quadripunctatus* Fabr. with reduced ocelligerous tubercles on the other. The size of the antennal scapes also varies to the extreme condition seen in *erythraeus,* another point of approach to *quadripunctatus.* No name has been found which strictly applies to this group of Nearctic flies although Palaearctic relatives were at one time wrongly included in *Atylotus* with *quatuornotatus* Meig., *tricolor* Zell., *gigas* Herbst., and other species, the last two being genotypes of *Therioplectes* Zell. and *Sziladya* End., respectively. While the first is unquestionably related to the above Nearctic group, neither of the others appears congeneric in the restricted sense on account of their general hairiness, including the subcalli, and the peculiar frontal characters and head shapes. If not already available, a name will undoubtedly be proposed eventually for this group, but the writer prefers the possible accusation of inconsistency by leaving them in *Tabanus* proper, without even subgeneric recognition, to separation on present inadequate grounds. The species with the more prominent eye hairs nevertheless admittedly show divergence toward *Hybomitra.*

*Neotabanus* Lutz (not Ricardo) is an even more problematic group which, corresponding to our *lineola* group as Stone pointed out, lacks sufficient structural differentation to support its recognition on the abdominal stripe alone, while showing various degrees of hirsuteness of the eyes. Very fine, sparse pile can even be seen on the eyes of some of the *vicarius* relatives, while they lack the outwardly produced head margins, and have different eye banding. On the other hand, *truquii* and most males of *lineola* have definitely hairy eyes. Doubt as to just which are congeneric with *trilineatus,* and if completely restricted as to the taxonomic utility of the name prevents its recognition among Nearctic genera at present. On head characters and the hairy subepaulets, *T. productus* Hine would appear more closely related here than to *Stenotabanus* where it was placed by Stone.

*Dudaella* Strand may be represented by *T. bishoppi* Stone and its relatives, but is not sufficiently differentiated for recognition at present.

From the restricted viewpoint, therefore, the Nearctic genera here assigned to the Tribe Tabanini are: *Tabanus* Linnaeus, *Hybomitra* End., *Glaucops* Szilady, *Leucotabanus* Lutz, *Atylotus* O. S., *Anacimas* End., *Microtabanus* Fairchild and *Whitneyomyia* Beq. Of these, only the last three are, so far as known, strictly Nearctic, though *Microtabanus* must be close to the Palaearctic *Surcoufiella* Beq. (*Baikalia*) which the writer has not seen.

The following key to genera is offered with full cognizance that certain restricting characters will not apply *in toto* to extra-Nearctic species.

## KEY TO NEARCTIC GENERA OF TABANIDAE

1. Anal vein of wings sinuous, anal cell open at the wing margin (Pelecorhynchinae) ..... *Bequaertomyia* Bren.
   Anal vein not sinuous, anal cell usually closed, often petiolate, seldom narrowly open ..... 2
2. Hind tibiae with 2 usually large apical spurs matching those of the mid tibiae (Pangoniinae) ..... 3
   Hind tibiae without such spurs (Tabaninae) ..... 14
3. Third antennal segment with 8 subequal divisions (Pangoniini) ..... 4
   Third antennal segment with only 3 to 5 divisions, the basal one (plate) about equal in length to all the remainder ..... 9
4. Eyes (♀) with upper inner angles sharply acute; wings with a wide, sharply marked, irregular, opaque pattern ..... *Goniops* Ald.
   Eyes (♀) above at most right angled (*A. colei* slightly acute); wings hyaline or diffusely tinted ..... 5
5. Proboscis hardly half the height of the head; palpi usually shorter than the antennae, little shorter than proboscis and swollen basally ..... 6
   Proboscis about equal to height of head (when shorter, palpi long and slender), palpi subequal to length of antennae, half or less that of proboscis, not swollen basally ..... 7
6. Eyes bare ..... *Apatolestes* Will.
   Eyes and body abundantly pilose ..... *Comops* Bren.
7. Cell $R_5$ closed and petiolate ..... *Esenbeckia* Rond.
   Cell $R_5$ open at wing margin ..... 8
8. Eyes hairy (short in ♀); base of vein $R_4$ with short spur; robust species ..... *Pilimas* Bren.
   Eyes bare; $R_4$ often without spur; mostly slender, smaller species ..... *Stonemyia* Bren.
9. Third antennal segment with 5 divisions (4 annuli) (Chrysopini) ..... 10
   Third antennal segment with 3 divisions (2 annuli) (Merycomyini) ..... *Merycomyia* Hine
10. Eyes in life (or relaxed) "freckled" with small rounded spots; pedicel of antenna either about half the length of the scape, or distinctly longer than flagellum; wings hyaline or with isolated clouds* on cross-veins ..... 11
    Eyes in life (or relaxed) with large angular spots; scape and pedicel usually subequal, the flagellum as long or longer than either; wings usually with irregularly, extensive dark pictures ..... 13
11. Flagellum of antenna much shorter than either of the basal segments and shaped like a bowling-pin with a bent neck (pseudo-annulations often give appearance of more than 4 annuli), pedicel nearly as long as scape ..... *Assipala* Philip
    Flagellum of antenna at least longer than pedicel, the latter only about half as long as scape ..... 12
12. Flagellum longer than 2 basal segments combined ..... *Silvius* Meig.
    Flagellum about 3/4 as long as scape alone ..... *Silvius* subg. *Zeuximyia* Philip
13. Abdomen globose, much wider than thorax; wings evenly fumose, a spur at base of vein $R_4$ ..... *Neochrysops* Walton
    Abdomen normal; wings mostly with irregular dark patterns, no spurs (except adventitiously) ..... *Chrysops* Meig.
14. Subepaulets bare ..... 15
    Subepaulets with hairs like those on the costal vein ..... 20
15. At least anterior tibiae noticeably swollen; vein $R_4$ without spur basally ..... 16
    Tibiae normal; vein $R_4$ with basal spur ..... 17

**Assipala melanoptera* (Hine) of Costa Rica has uniformly smoky wings, but is outside the Nearctic range.

16. Wings with hyaline areas extensive, venation normal; only fore-tibiae swollen (Diachlorini) ..... *Diachlorus* O. S.
Wings predominantly black, apical half of vein $R_4$ turned strongly forward; all tibiae swollen (Bolbodimyini) ..... *Bolbodimyia* Big.

17. Bodies compact, uniformly greenish or yellow; eyes unicolorous; females without frontal callosities (Chlorotabanini) ..... *Chlorotabanus* Lutz
Bodies slender, pale gray or bicolored; eyes in life banded; females with frontal callosities (Stenotabanini) ..... 18

18. Bodies pruinose without distinct pattern, females with very wide fronts and no ocelligerous tubercles (palpi tumescent, not slenderized apically), males with vertical tubercles suppressed; beach inhabitors ..... *Aegialomyia* Philip*
Bodies bicolored or with a definite pattern, females with or without ocelligerous tubercles but fronts at least 3 times taller than basal width (Nearctic), vertical tubercles of males at least as high as adjacent eye margins ..... 19

19. Ocelligerous tubercles and rudimentary ocelli present in both sexes; palpi only moderately robust; fronts of females narrow (ratio at least 5:1, Nearctic) ..... *Stenotabanus* Lutz
No such tubercles, the vertical tubercle of the male completely pollinose; palpi very swollen; fronts of females moderately wide (ratio about 3:1, Nearctic) ..... *Agelanius* Rond.

20. Flagellum of antenna with 4 divisions; 1st antennal segment considerably longer than thick; eyes in life with irregular bands and spots (Chrysozonini) ..... *Chrysozona* Meig.
Flagellum of antenna usually with 5 divisions (rarely fewer by apical fusion); 1st antennal segment scarcely longer than thick; eyes in life banded or unicolorous ..... 21

21. Third antennal segment with a hook-like dorso-basal extension; eyes sparsely hairy (Dichelacerini) ..... 22
Third antennal segment seldom hook-like, and if so, eyes bare (Tabanini) ..... 23

22. Subcallus above antennae with erect, black hair laterally ..... *Dicladocera* subg. *Agkistrocerus* Philip
Subcallus without such hair ..... *Hamatabanus* Philip

23. Flagellum of antennae modified with 2 to 3 annuli, the articulations more or less fused and indistinct; small flies, 11 mm. and under ..... 24
Flagellum normal, 4 distinct annuli (in doubtful cases, abdomen without sublateral rows of spots); small to large flies ..... 25

24. Very small flies, length under 9.5 or rarely 10 mm.; frontal callosity (♀) missing or rudimentary; eyes ostensibly bare, unbanded in life ..... *Microtabanus* Fchld.
Length 9.5 to 11 mm.; frontal callosity distinct; eyes bare or very sparsely pilose, banded in life (or relaxed) ..... *Glaucops* Szil.

25. Vertex (♀) with a distinct, denuded ocelligerous tubercle, or (♂) with an elevated, anteriorly shining tubercle, (in doubtful cases eyes are densely pilose) ..... 26
Vertex without such tubercles, if raised in ♂, then completely pollinose (eyes bare, or sparsely but seldom densely [certain males] pilose) ..... 27

26. Eyes ostensibly bare; front (♀) narrow, the callosity long and linear; upper

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*Genotype, *Tabanus psammophilus* Osten Sacken. Included also are *T. magnicallus* Stone, and the Antillean species recently discussed by Bequaert (1940, Rev. Ent., 11:323-332), *T. caribaeorum* Beq., *T. atlanticus* Johns., *T. nervosus* Cur., *T. laevicallus* Szil., and *T. jamaicensis* (Newst.), the females of some of which have narrower fronts and longer palpi requiring eventual revision of some characters for extra-Nearctic application.

eye facets (♂) strongly differentiated and enlarged; scutellum pallid ..... *Leucotabanus* Lutz

Eyes usually distinctly pilose; front (♀) variable, but the basal callosity correspondingly broad; eye facets (♂) relatively undifferentiated; scutellum usually dark ..... *Hybomitra* End.

27. Eyes yellow to brown, distinctly pilose, particularly in males; front (♀) without callosities, or they are reduced to small, isolated bare spots (a single, diagonal, dark band on eyes, often showing even in dried condition) ..... *Atylotus* O. S.

Eyes blackish when dried, or in males at least lower areas of non-enlarged facets; bare, or if sparsely hairy, with more than one purple band in life and the abdomen may have a uniform, pale, mid-dorsal stripe; front (♀) with a broad basal callosity ..... 28

28. Antennae including annuli, and palpi with unusually erect hairs, palpi blunt and stout, the proboscis relatively, quite small; "postocular rim" (between eye margins and occipital hairs) unusually wide *Anacimas* End.

Not with this combination of characters, annular hair very inconspicuous, if present ..... 29

29. Body and wings entirely deep brown to black (although abdomen occasionally with pale lateral vestiture); frontal and facial callosities unusually protuberant and shining (eyes bare, in life with the upper of 4 purple bands strongly decurved and widened outwardly as in *Heptatoma*) ..... *Whitneyomyia* Beq.

Body and wings varicolored (when entirely black, over 15 mm. in length); eyes bare or sparsely hairy ..... *Tabanus* Linn.

### STENOTABANUS Lutz

A specimen of the genotype species, *Tabanus taeniotes* Wied., is available through kindness of Dr. J. Bequaert. The bare subepaulets appear to warrant tribal separation with related forms, but hardly subfamily treatment as accorded by Kröber. Such diverse forms as *daedalus* Stone with hairy subepaulets and no wing spurs, *productus* Hine with its *lineola*-like head shape and eye pattern in addition to its hairy subepaulets, and *psammophilus* O. S. and *magnicallus* Stone with their very reduced or missing vertical tubercles in the males and *Agelanius*-like characters, are not correctly included in the genus *Stenotabanus* on the mere basis of similarity of wing spurs, or antennal structure. While the above all have finely and very sparsely pilose eyes like *taeniotes*, this also has a definite ocellar tubercle in the female, and hence probably a *Hybomitra*-like structure in the male. However, the bare subepaulets, in addition to the antennal structure, readily separate it from *Hybomitra*. I would consider only *flavidus* Hine of the Nearctic species as strictly congeneric with *taeniotes*. Males of the two following species, assigned by Stone (1938) to *Stenotabanus*, have not previously been described.

*Tabanus cribellum* Osten Sacken. Location of the three cotypes has been listed as unknown. Mr. Oldroyd informs me two of them are now in the British Museum, and Dr. Stone has found two of the seven cotypes of its synonym, *T. guttatulus* Towns., in the U. S. National Museum.

Allotype ♂, 11 mm. Head a little wider than thorax, eyes with almost imperceptible, short, sparse hairs, upper eye facets but slightly enlarged occupying about half the total area, two rather broad greenish bands on a purple ground (relaxed) crossing the lower area of smaller facets. Vertical tubercle small, dark about even with the upper eye level, and pale yellow hirsute. Frontal triangle gray-buff pollinose, with a darker, bare cross band in the upper third. Antennae reddish, a little darker apically, shaped and invested essentially as in the female, the annuli a little longer than the plate of the third segment, the dorsal angle

slight. Palpi pale creamy, with long white hairs; second segment very swollen, its length scarcely twice its thickness, with an apical downwardly and inwardly pointing nipple. The tongue blackish, labellae large, a little longer than the palpi. The body pattern and remaining appendages essentially as in the female, the vestiture in general longer, the subepaulets bare, wing spurs moderately developed.

Yermo, San Bernardino Co., Calif., May 23, 1940, W. Reaves, M. Cazier and P. C. Ting; in the collection of the author through courtesy of Dr. T. H. G. Aitken.

Another male from Las Mochis, Sinaloa, Mexico, is in essential agreement, but smaller, and with a more pronounced orange suffusion of the abdomen and legs possibly due to wear.

This species and its relative, *T. stigma* Fabr. of the West Indies, do not appear to belong in *Stenotabanus* and differ from the species of *Aegiolomyia* in the narrower fronts, bare vertices, and attenuated palpi of the females, the evident vertical tubercles and less differentiated eye facets of the males, and bicolored body patterns. They are assigned provisionaliy to the Neotropical genus, *Agelanius* Rond., although the genotype is not available for comparison.

*S. daedalus* Stone. Allotype ♂, 10.5 mm. Head rather large, upper eye facets about two-thirds of the total area; not greatly enlarged but brown in contrast to the greenish smaller facets below which are crossed by an indistinct purplish band even in the dried condition; pile not perceptible. Vertical tubercle small, grayish, pollinose and slightly depressed. Frontal triangle pale brownish pollinose. Face and cheeks gray with white pile. Antennae light yellowish brown, a little darker on the apical annulus, first two segments rather slender, the dorsal tooth of the second reduced, third with a rounded, obtuse dorsal angle, hardly excavated,, annuli tapered, indistinct, two or possibly three in number. Palpi pale creamy, very slender about half the length of the dark tongue, covered with white hair and a few scattered black ones apically, length of second about two and one-half times its thickness. Mesonotum blackish, without evident lines, but covered with a bright, yellowish pollinosity and sparse yellow pile. Pleurae and sternum gray with white pile. Legs (not originally described) with fore coxae buff gray with white pile, trochanters dark brown which color extends slightly onto the fore femora below, remainder bright yellowish with concolorous hair and a few black ones at the tips of the tibiae. most extensive on the fore pair, tarsi dark. Wings hyaline, with yellowish veins and costal cells, no spurs. *Subepaulets with appressed black hair.* Abdomen yellowish-brown above and below, with indications of three dorsal rows of lighter spots. From Volusia, Fla., 6 mi. W. of Barberville, Sept. 6, 1938. In the collection of the author.

The peculiar reduction in the number of annuli of the third antennal segment makes generic assignment problematic and the species is provisionally placed with *fratellus* in *Glaucops.*

### DICLADOCERA Lutz

The Nearctic species included here by Stone (1938) are not strictly congeneric with *D. guttipennis* (Wied.), the genotype from South America, nor with *T. ater* Rossi of Europe, the genotype of the subgenus *Dasyramphis,* as both have bare subepaulets and unbanded eyes. The produced dorsal antennal teeth by which they are associated is admittedly heterogenetic, and possibly would not be considered to warrant the same tribal attention the character receives in the more elaborated or typical Dichelacerini of the Neotropical Region. Except for this tooth, *T. megerlei* Wied. shows some affinities to the European *T. gigas* and *T. tricolor* with their characteristic head shapes, lack of ocelligerous tubercles, and hairy subcalli. Nevertheless, the hairy subcalli undoubtedly relate *megerlei* to the Neotropical species of *Dicladocera,* although the hairy sub-

epaulets and banded eyes in life indicate it and probably *D. finitima* Stone should be placed in a separate subgenus, here proposed as AGKISTROCERUS subgen. nov. (Gr., "fishhook + horn") with the former as genotype species.

*D.* (*A.*) *megerlei* (Wied.), the male is undescribed. Allotype ♂, 17.5 mm. Easily associated with the female by the uniform, black, mid-dorsal band on the brick-red abdomen, and the prominent clouds on the wings. The whole body broad, the abdomen flattened, and rounded posteriorly.

Head broad, rather flat across the top; the vertical tubercle raised above the adjacent eye margin, deep brown pollinose, with abundant black hair posteriorly, and evidence of three small, vestigial ocelli (these are also sometimes observable in the ♀ below the vertex). Eyes with abundant brown hairs, facets little differentiated, (relaxed) evidence of two green bands; frontal triangle brown pollinose, darker laterally, broader than tall, depressed mesally, and with striking, coarse, black hairs on the lateral swellings; cheeks and face deep brown with darker, abundant hair; the back of the head with fine yellowish hair. Antennae red, annuli black, the first segment rather large, equal in height to the third, the second with a dorsal tooth, both covered with black hairs, the third deeply excavated, the dorsal tooth practically reaching the base of the annuli. Palpi dark brown, about two-thirds the length of the tongue, covered with black hair, the second segment about twice as long as thick, slightly bent downward in a blunt point apically. Thorax darker than in the female, the pleural, coxal and femoral hair longer, almost black. Femora darker brown than the tibiae, outer fore-tarsal claw slightly elongated. Wings as in the female, subhyaline apically, brownish baso-costally with clouds on the cross-veins, the subepaulets small and covered with black appressed hairs. The black median band and lateral margins broader than in the female, the red intervals with whitish hairs providing an appearance of five contrasting, full length stripes. Venter predominantly red, covered with black hairs, whitish on the incisures and suggestions of a narrow mesal black stripe, the lateral margins narrowly black.

Gulfport, Pinellas Co., Fla., March 3, 1928. In the collection of the author.

Two females from Mississippi have darker appendages, black callosities, the palpi blackish and more slender than more eastern specimens studied by the writer.

The other three smaller Nearctic species with hooked antennae, viz., *scita* Wlk., *annularis* Hine, and *sexfasciata* Stone, which lack hairs on the subcalli are hardly congeneric in the restricted sense with *megerlei*. As the hairy subepaulets, rather wide post-ocular rims, and abdominal patterns with three rows of spots exclude them from any Neotropical genera known to the writer, the name HAMATABANUS gen. nov. (L., "hook + tabanus") is proposed with *Tabanus scita* Walker as genotype. The head shape and characters, body pattern and more slender build suggest an independent divergence from the parent stock compared to the species of *Dicladocera*. The eyes (relaxed) of *scita* and *sexfasciata* show a single purple band on a green ground while those of *megerlei* are purple with two green bands.

In the Neotropical *Chelommia* End., which is also related here, the genotype, *cinnamomeus* Schin., also has hairy subepaulets, but the eyes unbanded and ostensibly bare, the head rounded, not flattened above the post-ocular bristles on the immediate eye margin (no "rim"), and the antennal tooth produced to the base of the annuli; fine hairs are also seen laterally on the subcallus of this species, which, with the vestigial ocelli, would indicate closer relationship to *Agkistrocerus* than to *Hamatabanus*.

In summary, the proposed arrangement of the supra-specific categories of the Nearctic Tabanidae is as follows:

Subfamily I. Pelecorhynchinae Enderlein.
Tribe 1. Bequaertomyini Philip.
(1. *Bequaertomyia* Bren.).
Subfamily II. Pangoniinae Loew.
Tribe 1. Pangoniini Enderlein.
(1. *Goniops* Ald., 2. *Stonemyia* Bren., 3. *Pilimas* Bren. 4, *Esenbeckia* Rond., 5. *Apatolestes* Will., and 6. *Comops* Bren.).
Tribe 2. Chrysopini Enderlein.
(1. *Chrysops* Meig., 2. *Neochrysops* Walton, 3. *Assipala* Philip, and 4. *Silvius* Meig.).
Tribe 3. Merycomyini Philip.
(1. *Merycomyia* Hine).
Subfamily III. Tabaninae Loew.
Tribe 1. Diachlorini Enderlein.
(1. *Diachlorus* O. S.).
Tribe 2. Bolbodimyini Philip.
(1. *Bolbodimyia* Big.).
Tribe 3. Chlorotabanini Philip.
(1. *Chlorotabanus* Lutz).
Tribe 4. Stenotabanini Philip.
(1. *Stenotabanus* Lutz,
2. *Agelanius* Rond., and
3. *Aegialomyia* Philip).
Tribe 5. ? Dichelacerini Enderlein.
(1. *Dicladocera* subgen. *Agkistrocerus* Philip, and 2. *Hamatabanus* Philip).
Tribe 6. Chrysozonini Philip.
(1. *Chrysozona* Meig.).
Tribe 7. Tabanini Enderlein.
(1. *Microtabanus* Fchld., 2. *Glaucops* Szil., 3. *Atylotus* O. S., 4. *Anacimas* End, 5. *Leucotabanus* Lutz, 6. *Hybomitra* End., 7. *Whitneyomyia* Beq., and 8. *Tabanus* Linn.).

*Archeomyia* gen. nov. is also erected for a group of pelecorhynchine flies in Australia with widely dichoptic eyes in the males, genotype species *Pelecorhynchus fulvus* Ricardo.

I am deeply indebted to the following for many helpful suggestions and criticisms, and for loan of materials to many other persons and institutions of whom space does not permit specific mention: Drs. Alan Stone, J. C. Bequaert, L. L. Pechuman, and Messrs. G. B. Fairchild and H. Oldroyd. Their opinions contributed materially to the decisions and final conclusions of the writer in these studies.

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# NEW SPECIES OF TRICHOPTERA FROM CANADA AND NORTHERN UNITED STATES

BY HERBERT H. ROSS,

Illinois State Natural History Survey, Urbana, Illinois.

Most of the species described in this paper have been sent to me for identification by various students of limnology to whom I wish to express my appreciation for their cooperation. Types are in the collection of the Illinois State Natural History Survey, unless otherwise stated. I am indebted to Dr. C. O. Mohr of the Survey for considerable assistance with the drawings.

## **Agraylea costello** n. sp.

*Male.* Length 4 mm. Head, body and wings dark brown, with salt and pepper fleckings, antennae and legs pale yellow. General structure typical for genus. Most closely related to the European *pallicornis* Eaton, differing from it in the down-curved tenth tergite and the truncate apical margin of the claspers. Genitalia as in fig. 1. Ninth segment with invaginated portion short and round. Tenth tergite with two parts, a wide dorsal piece produced ventro-laterad like a collar and a beaked process extending beyond it and curved ventrad. Claspers subquadrate, the dorsal margin bearing a lobe arising near the lateral margin and ending in a sharp point. Aedeagus, fig 1A, with a long basal tube, a distinct, cylindrical neck, a short coiled spiral process and a cylindrical apex.

*Holotype*– ♂, Costello Lake, Algonquin Park, Ontario, Ontario Fisheries Research Laboratory, Cage number 4, August 27, 1938, W. M. Sprules.

*Paratypes* –Same data, 1 ♂; July 7, 1 ♂.

## **Oxyethira araya** n. sp.

*Male.* Length 3.4 mm. Color the common salt and pepper pattern of light and dark grays in common with so many members of this family. General structure typical for genus. Most closely related to *serrata* Ross but differing in the conformation of the genitalia, fig. 2. Seventh sternite with a short, pointed, apical process. Eighth segment with a broad, lateral, basal plate inserted into the seventh segment; lateral margin with a stout, dorsal process, subdivided into a long and a short apical point. Genital capsule retracted within the eighth segment but without long, basal projections. Dorsal margin of ninth segment produced into a sinuate, stout, sclerotized rod. Claspers apparently fused on the meson and together forming a thick, U-shaped structure; the central portion is clothed with abundant, stout setae which taper to a thin, flat apex devoid of setae but with a darkened edge. Tenth tergite beaked, the two lobes separate at base, angulate near middle, and coming together in a narrow, truncate tip, below which arises a pair of styles bearing a long seta at apex. Aedeagus, fig. 2A, with basal portion very short, neck inconspicuous, and apical portion over four times length of base; spiral process, stout and ribbon-like, completely encircling apical portion.

*Holotype*– ♂, Hampton, New Brunswick, Aug. 20, 1939, T. H. Frison & T. H. Frison, Jr.

## **Oxyethira zeronia** n. sp.

*Male.* Length 2.5 mm. Color and general structure identical with the preceding. Genitalia, fig. 4, most closely resembling *verna* Ross, but differs in the very different structure of the aedeagus and in the narrowed, lateral apex of the eighth segment. Seventh segment with a minute, apical projection. Eighth segment with dorsal margins irregular, lateral face produced at apex into a short, thumb-like, rounded lobe, and ventral margin bi-emarginate, due to the lateral projections and small mesal lobe. Ninth segment with a

ventro-basad projection which is as long as four-fifths the length of the aedeagus and which is narrow in both longitudinal planes, remainder of sclerotized reinforcing of segment forming only a small, lateral triangle. Claspers small, somewhat biscuit-shaped, and clothed with short, scattered setae. Tenth tergite beaked. Aedeagus, fig. 4A, with basal portion longer than the remainder, neck undifferentiated, apical portion composed of a short, filament-like appendage at base, membranous folds along one side and two sinuate, sclerotized rods.

*Holotype*—♂, Twin Lake, Houghton Co., Michigan, Aug. 20-22, 1937, H. H. Ross.

### **Hydroptila xonela** n. sp.

*Male.* Length 2.2 mm. Color the usual salt and pepper mixture typical of the genus. General structure typical for genus in regard to spur count, thoracic sclerites, and wing venation. Male genitalia, fig. 3, most similar to *waubesiana* Betten but differing in the parts mentioned. Ninth segment almost completely retracted within the eighth and seventh, this portion rounded at apex; the segment is reduced dorsad to a very narrow area which merges completely with the tenth tergite; near the meson the dorso-lateral portion is produced into a rounded flap which covers the baso-lateral corner of the tenth tergite. Tenth tergite almost entirely semimembraneous, narrow at base, widening towards apex, the apical region divided into a narrow, parallel-sided, mesal flap and a pair of twisted and flaring lateral lobes. Claspers long and sinuate, expanded near apex, the extreme apico-lateral corner sclerotized, pointed, and hooked. Ventral plate extending almost three-quarters the length of the claspers and with a pair of erect setae near apex. Aedeagus with sinuate basal portion, bulbous neck, small spiral process and long, slender apex, fig. 3A.

*Holotype*—♂, Moser River, Nova Scotia, July 29, 1939, Gold Mine Brook, J. A. C. Nicol.

### **Hydroptila ampoda** n. sp.

*Male.* Length 2.5 mm. Color and general structure typical for genus. Seventh sternite with a sinuate, mesal projection, as in *amoena, hamata,* etc. Eighth segment with sclerotized areas as in other members of the genus. Genitalia, fig. 5, most closely related to *amoena* Ross, but differs markedly in the very slender claspers and intwined processes of the aedeagus. Ninth segment with lateral margin produced into long, basal, tail-like areas. Tenth tergite long, up-turned, and divided into slightly divergent lobes. Claspers with a slender, mesal, beak-like portion clothed with abundant, minute setae and a lateral, rounded, thumb-like lobe bearing a few short and two or three long macrochaetae. Aedeagus with basal portion relatively short and somewhat irregular in shape; neck short; spiral process broad but short, encircling the segment only one-half times and closely appressed to it; apical portion immediately divided as in fig. 5A.

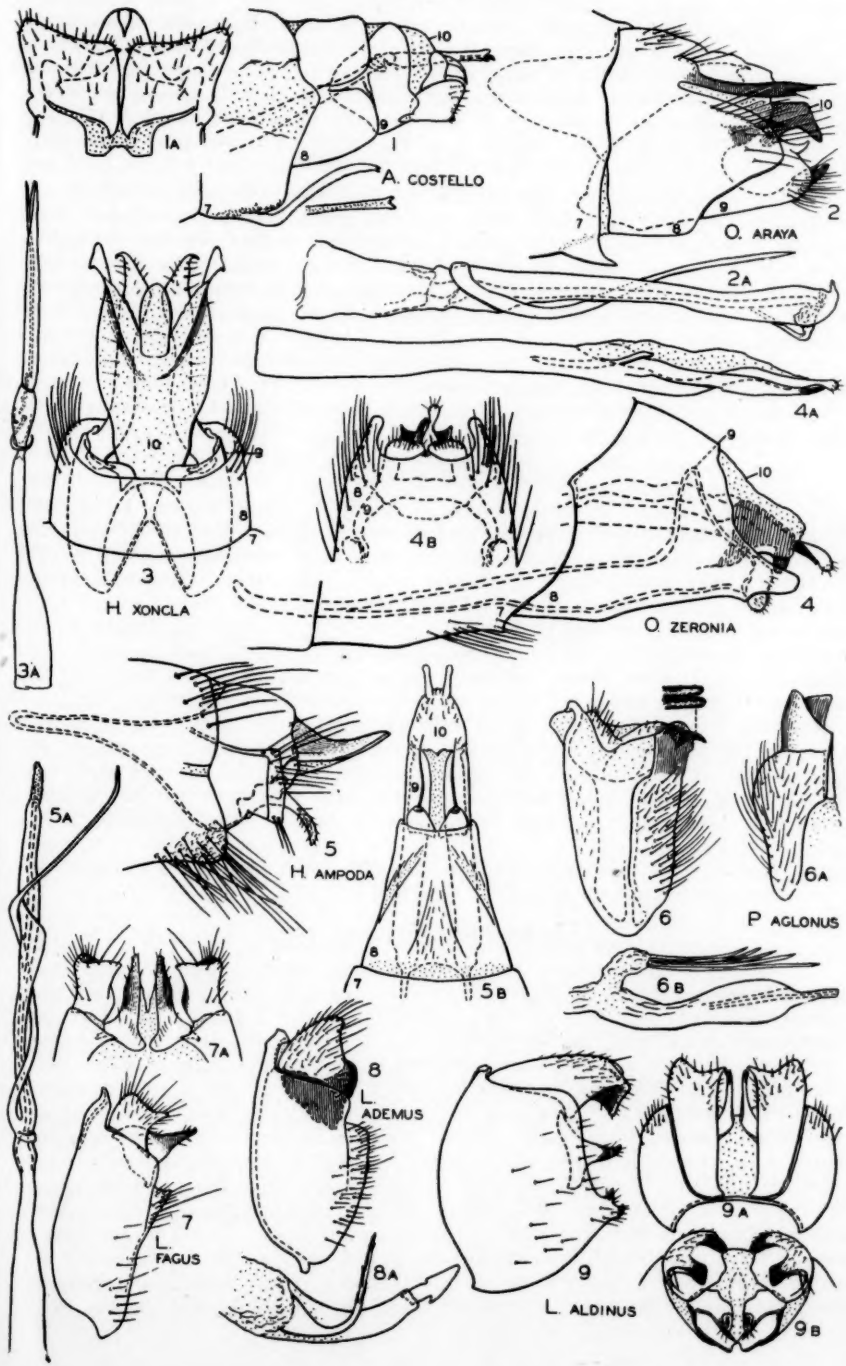
*Female.* Size and general structure as for male. Genitalia as in fig. 5. Eighth segment almost unsclerotized; projecting beyond the apex is a pair of flat, rounded, ventral lobes closely appressed to the ninth segment, separated on the meson by only a short distance and bearing a single, long, sinuate spine. Ninth segment very long and narrow, venter with a membranous groove running down the meson.

*Holotype*—♂, Moser River, Nova Scotia, July, 1939, Gold Mine Brook, J. A. C. Nicol.

*Allotype*—♀, Same data.

*Paratypes*—Nova Scotia: Same data, 1 ♂. Quebec: Grand Lac Jacques Cartier, Laurentian National Park, April 11, 1938, 2 ♂.

PLATE I.


1A
1
A. COSTELLO
2
O. ARAYA
2A
4A
3
H. XONCLA
4B
4
O. ZERONIA
3A
5A
5
H. AMPODA
5B
6
P. AGLONUS
6A
6B
7A
7
L. FAGUS
8
L. ADEMUS
8A
9
L. ALDINUS
9A
9B

**Pycnopsyche aglonus** n. sp.

*Male.* Length 15 mm. Color a light brown, with the antennae darker, mouthparts, venter, and legs, tawny, spines on the legs black, and wings practically unmarked. General structure typical for genus. Legs with a spur count of 1-3-4. Eighth tergite with apico-lateral corners produced into short, sharp, upturned points. Genitalia, fig. 6, most closely related to *limbatus* (McL.), differing in the shape of the claspers. Tenth tergite with two lateral, sclerotized plates which converge into a pair of parallel, flat and down-curved processes. Claspers with a robust basal portion covered with a brush of abundant long and short setae; the apex is divided into a convex, broad, dark plate rounded above and narrowing abruptly to the meson; behind this plate is another triangular plate inserted on its inside margin and seen only from caudal or dorsal view. Aedeagus with a membraneous base supporting a mesal irregular structure and a pair of membraneous, semi-globose cups each bearing a cluster of five long, appressed setae.

*Holotype*—♂, Costello Lake, Algonquin Park, Ontario, Ontario Fisheries Research Laboratory, Cage number 5, August 3, 1938, W. M. Sprules.

*Paratypes*—MASSACHUSETTS: 1 ♂ (Collection of M. C. Z.). ONTARIO: Same data as for holotype, but August 20, 1939, 1 ♂.

**Limnephilus fagus** n. sp.

*Male.* Length 12 mm. Color of head, thorax, abdomen, coxae, and femora dark brown with warts lighter brown to straw color; tibiae and tarsi straw color, variegated with yellowish brown; front wings dark brown with a flecking of light spots giving it a salt and pepper appearance. General structure typical for genus. Front tibiae with a single, pointed, yellow, apical spur; basitarsus one and one-half times length of succeeding segment. Eighth tergite produced, knob-like; dorsal mesal lobe studded with short, black spines. Male genitalia, fig. 7, most closely related to *despectus* Walker but differing in the larger tenth tergite which is bulbous at the base and in the shorter, stockier cerci. Tenth tergite extending considerably beyond the cerci, the apical portion narrow, dark, and minutely serrate above, its base arcuate and large. Cerci subquadrate, the apico-dorsal corner produced into an acute angle, seen from dorsal view, produced mesad into a flat, heavily sclerotized, and triangular point. Claspers small and triangular. Aedeagus identical with that of other members of this group.

*Holotype*—♂, Corvallis, Oregon, May 19, 1938, Oak Creek, Knight.

*Paratypes*—Same data, 2 ♂.

**Limnephilus ademus** n. sp.

*Male.* Length 9 mm. Appearance robust, color medium brown with scattered patches of darker brown on the dorsum and wings. Head with three pairs of macrochaetae very well developed, typical for genus. Front legs with femur stout and bearing a brush of black setae against which tibia fits; tibia short, armed at apex with a stout, black spur and beneath with a strip of short, black setae continuous from base to apex; basitarsus one-half length of succeeding segment. Spur formula 1-3-4; spurs on middle and hind legs yellow; both tibiae and tarsi heavily armed with black spines. Wings with prominent rows of spines along veins, especially in the anal region. Abdomen with all segments simple except genitalia, the eighth segment without projections or clusters of spines. Male genitalia, fig. 8, close to *secludens* (Banks) and *tarsalis* (Banks), but differing in the short aedeagus with up-turned lateral arms. Tenth tergite formed into a pair of lobes which are wide at base, heavily sclerotized, and produced into a sharp and slightly recurved tip directed laterad. Cerci somewhat triangular, the mesal surface unarmed except for an indistinct thickening on the small,

central angulation of the caudal margin. Claspers forming a narrow sclerite along the genital capsule. Aedeagus with central cylinder broad at base, tapering abruptly and bent upward; lateral arms with a wide, flat base tapering abruptly to an upcurved rod composed of very fine, appressed lamellae.

*Holotype*– ♂, Hampton, New Brunswick, August 20, 1939, T. H. Frison and T. H. Frison, Jr.

**Limnephilus aldinus** n. sp.

*Male.* Length 15 mm. Color of head, body, and appendages, including wings, various shades of medium and dark brown with the apical segments of the legs lighter. General structure typical for genus. Dorsum of head with a black macrochaetae before and behind each lateral ocellus. Front legs with basitarsus subequal in length to the two following segments; tibial spur long and yellow. Eighth tergite simple. Genitalia, fig. 9, closest to *curtis*, differing in the conformation of the cerci, especially the dorsal view. Cerci long, the dorsal face widening from base to apex, the apex with a wide, emarginate "V"; lateral face with apex excavated into a concave fold; posterior aspect with two, heavily sclerotized, blunt, flat teeth separated by some distance at their base. Tenth tergite composed of a pair of lateral plates, each with a broad base and a narrow tapered apical portion which is pointed and heavily sclerotized at apex. Claspers incised at apex to form a pair of hook-like points. Aedeagus typical for group.

*Holotype*– ♂, Waterton Lakes Park, Alberta, August 11, 1937, Middle Rowe Lake, D. S. Rawson.

EXPLANATION OF PLATE I.

Fig. 1.—*Agraylea costello*, lateral aspect; 1A, ventral aspect of claspers.
Fig. 2.—*Oxyethira araya*, lateral aspect; 2A, aedeagus.
Fig. 3.—*Hydroptila xoncla*, dorsal aspect; 3A, aedeagus.
Fig. 4.—*Oxyethira zeronia*, lateral aspect; 4A, aedeagus; 4B, ventral aspect of genitalia.
Fig. 5.—*Hydroptila ampoda*, lateral aspect; 5A, aedeagus; 5B, female genitalia, ventral aspect.
Fig. 6.—*Pycnopsyche aglonus*, lateral aspect; 6A, clasper, caudal aspect; 6B, aedeagus.
Fig. 7.—*Limnephilus fagus*, lateral aspect; 7A, cerci and lobes of tenth tergite, caudal aspect.
Fig. 8.—*Limnephilus ademus*, lateral aspect; 8A, aedeagus.
Fig. 9.—*Limnephilus aldinus*, lateral aspect; 9A, cerci and tenth tergite, dorsal aspect; 9B, same, caudal aspect.

## NOTES

### WORK OF FARNHAM HOUSE TRANSFERRED TO CANADA

The many friends of Dr. W. R. Thompson, Superintendent of the Farnham House Laboratory, Farnham Royal, England, will be interested in learning that for the duration of the war he is now established in Canada at the Dominion Parasite Laboratory, Belleville, Ont. Here he will continue inter-imperial activity on the biological control of harmful insects. Doctor Thompson reached Belleville on August 22 and office and laboratory facilities have been placed at his disposal by the Division of Entomology of the Dominion Department of Agriculture.

The Farnham House Laboratory at Farnham Royal, England, was closed for the duration of the war on October 15. The work of the laboratory for the various colonies and dominions of the British Empire will be continued from Belleville.

Arthur Gibson.

## THE CONTROL OF HUMAN LICE UNDER WAR CONDITIONS

As always happens during wars, outbreaks of body and crab lice cause concern to medical officers in the army and various, but rather inconvenient, control methods are in use. Where the standard British Army machinery for applying heat is available for body lice, control is simple enough, but such machinery is not available among the widely scattered units of our citizen army. On the point of embarking for France during the last war, a chance-met English officer emphasized to me the importance of lice and recommended lavender oil, procurable at that time anywhere in England at one shilling per ounce, for their prevention and control. The first time over I took an ounce vial and on my first leave and thereafter, a four-ounce bottle of this oil. Rubbed on the ankles, neck, wrists and waistline, it certainly seemed to deter body lice whose establishment, on the few times that they escaped the lavender oil barrier, was prevented by my using silk underwear. Application of the oil to lice in the seams of clothing killed them very quickly. I always carried a stock for my troops and while the smell sometimes laid them open to merciless chaffing, they were never lousy for long.

With the recruiting of large numbers of men in Vancouver during the war, I was consulted about outbreaks of body and crab lice on the troops. The army formula prescribed for body lice, which had already been put into force on a platoon of men, was a marvel of archaic ideas dating apparently from the Crimean wars and consisting of a combination of all methods recommended since that time. Its publication here is forbidden me on the plea of military secrecy and thus a gem of insect control is lost to the entomological world. To my amazement, there were no casualties among the troops who had been treated.

In place of these military methods for body lice, I recommended the use of derris powder, dusted and rubbed into the seams of all underwear and uniforms. The sanitary sergeant told me that the powder caused no irritation to the men and there have been no complaints since about this species. It has not been possible for me to conduct personal tests against this insect but from long experience with derris in the control of lice on dogs and fleas on cats and dogs, I would say that it should provide complete control and its availability, convenience of storage and transportation, and ease of application should recommend it for this purpose.

For crab lice I recommended the mosquito repellent Sta-way, which is reported by Phillip Granett in the Journal of Economic Entomology, June 1940, page 566, as consisting of diethylene glycol monobutyl ether acetate, diethylene glycol monoethyl ether, ethyl alcohol, corn oil and perfume. It is prepared in this country by the Canadian National Carbon Company and can be procured from any drug store, costing locally 35 cents for a two fluid ounce bottle. The sanitary sergeant reported satisfactory control with this liquid and brought over an infested soldier for my inspection. Applied with a piece of cotton wool or an old shaving brush so as to reach the roots of the hair, Sta-way causes crab lice to loosen their hold and to fall off within a few seconds and to die very shortly. Over-enthusiastic application so that the liquid runs down over tender skin produces only temporary tingling as occurs with the use of shaving lotion, and no subsequent ill effects. Inducing the patient to stand over a sheet of paper and to watch the insects fall increases the popularity of the treatment. I supplied the liquid free for the privilege of retaining duplicates and the man departed with the air of having conferred a benefit upon mankind. Sta-way now constitutes a regular part of the army medical equipment in this area for use against crab lice; it should prove equally effective against head lice.

G. J. Spencer,
The University of British Columbia

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